USDA National Agroforestry Center

AGROFORESTRY NOTES

AF Note — 40

May 2008

Indicators and guidelines for landscape assessment and planning for agroforestry

Assessments and plans

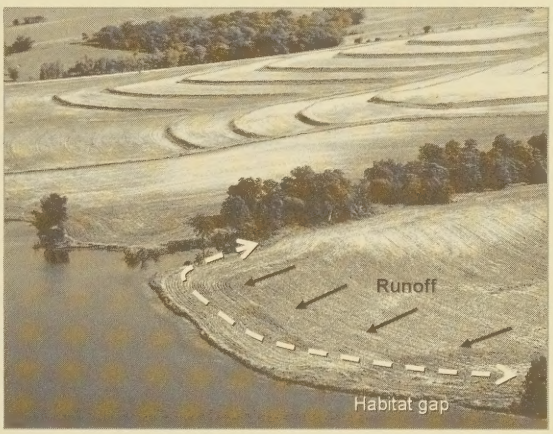
Agroforestry practices can produce numerous environmental benefits that become significant only through multiple installations over a large area, including greater diversity of wildlife, healthier aquatic ecosystems, and cleaner stream water. Through landscape-level assessment and planning, a limited number of agroforestry installations can deliver significant improvements if designed and placed in critical locations.

Indicators and guidelines

Agroforestry produces environmental benefits by altering landscape structure and modifying the flow of resources across the landscape. Since you normally can't see these processes, you need to look for indicators of them in the patterns of land cover and land form that comprise landscape structure. An assessment of existing patterns can reveal potential resource problems. Guidelines, then, can be used to select locations and designs for agroforestry that will modify existing patterns and produce desired environmental benefits. The following sections provide some useful indicators and guidelines.

Terrestrial wildlife

Indicators: Look at the pattern of permanent vegetation and water sources among agricultural and other developed areas. Large patches of permanent vegetation that include water sources are viable habitat for many species and can produce more wildlife for migrating to other patches. Forest patches favor forest species and grassland patches favor grassland species. Edges of patches and corridors favor edge species and habitat generalists. Small, unconnected fragments of permanent vegetation may lack sufficient water, food, or cover for maintaining wildlife populations.



In this landscape, small widely-spaced forest patches among cultivated fields near the lake indicate an exceptional opportunity for improving wildlife and water resources. Guidelines suggest that an agroforestry practice will enhance forest habitat to a greater degree when placed close to the lake and connects existing woody corridors and patches. Water quality improvement also will be gained from locating it downhill from a cultivated area. *USDA NRCS file photo.*

Look for corridors that enable wildlife to move among patches of suitable habitat. Corridors that connect small patches to large patches provide conduits for wildlife to re-colonize unpopulated patches and provide access to habitat needs that may be lacking in the small patches. Wide breaks in the continuity of vegetative cover, including tilled or mowed areas, roads, and other developments, create gaps that can act as barriers and hazards for wildlife movement.

Guidelines for enhancing terrestrial wildlife

- Locate agroforestry practices close to streams, ponds, and wetlands.
- Locate agroforestry practices next to existing forest patches or other suitable habitat, including field borders and riparian buffers, to enlarge existing habitat areas and to connect patches.
- Locate and shape agroforestry areas so that when combined with adjacent habitat it creates block-shaped patches for promoting interior forest species, elongated patches for promoting edge species, or corridors for connecting habitat patches across the landscape.
- Select the agroforestry type and tree species that can create the appropriate forest structure for enhancing desired species of wildlife.
- Locate agroforestry away from important grassland habitat.

Water quality

Indicators: Look at the pattern of areas disturbed by cultivation, livestock, and urban development, natural and man-made waterways, and permanent vegetation among the disturbed areas and waterways. More pollutants are generated from areas disturbed by tillage and fertilization, livestock confinement, and urban construction, particularly where they occur on steeper land and in frequently-flooded areas. Water runoff from disturbed land flows downslope into natural channels, but constructed waterways such as ditches, terraces, subsurface drainage tiles, and culverts, concentrate runoff flow and often divert it across natural slopes. Infiltration moves soluble nutrients and pesticides into soil and shallow aquifers.

Large patches of permanent vegetation that cover entire watersheds can protect stream networks and underlying aquifers by stabilizing soil and minimizing chemical and manure inputs. Smaller patches of permanent vegetation that lay in the path of runoff flow before it enters a stream channel or drainageway can filter some pollutants from runoff water. Groundwater that flows within a few feet of the ground surface can be filtered among roots of vegetation. Groundwater is often shallowest in riparian areas and floodplains. Patches on low floodplains can also trap pollutants in floodwater. Greater impact is produced where runoff flow is slow and dispersed throughout a patch of permanent vegetation. Larger patches can filter larger runoff loads.

Guidelines for reducing water pollution

- Locate agroforestry practices in disturbed areas that generate greater pollutant runoff loads, such as cultivated areas and livestock confinements on steeper slopes and in floodplains.
- Locate agroforestry practices immediately downhill from major source areas and in other areas where runoff water tends to concentrate prior to entering a channel or drainageway.
- Orient row or strip-type agroforestry plantings along topographic contours.
- Locate agroforestry practices in floodplains and riparian areas to filter shallow groundwater.
- Size agroforestry practices to be larger/wider on sites that intercept greater runoff load.

Aquatic wildlife

Indicators: Look at the pattern of stream channels and land cover along them. A long straight channel through agricultural land can indicate that the stream has been intentionally straightened, cleared, and cleaned of debris. Extensive agricultural and urban development can increase storm flows that erode banks and scour debris from channels. Lack of riparian forest exposes the channel to

sunlight and high summer air temperatures which increase water temperature. Dams and drop structures can block fish migration to and from reaches that have suitable habitat.

Large patches of permanent vegetation that cover entire watersheds protect aquatic systems and maintain natural flow regimes. Riparian forest provides temperature-moderating shade during summer and contributes debris to channels that provide habitat structure and food for aquatic organisms. Meandering channels are more resistant to channel scour and have more-diverse pool and riffle structure. Free-flowing streams enable fish to migrate between suitable habitats.

Guidelines for enhancing aquatic wildlife

- Locate agroforestry practices along streams and shores (riparian zones), especially where they maximize shade to streams during summer months.
- Riparian corridors should be wide enough to provide adequate debris and shade to the stream.
- Locate agroforestry practices where they connect to existing riparian forest and fill gaps that will create longer reaches of continuous forest vegetation.
- Select fast-growing, tall tree species that will quickly produce dense shade.
- Select flood-tolerant trees along streams where frequent flooding is expected.

Stream bank stability

Indicators: Look at the pattern of stream channels, land cover along them, and the extent of land development around them. Channel incision and bank erosion may stem from runoff-increasing land development and drainage improvements, removal of riparian forest, and channel straightening at and upstream of the site. Channel dredging and straightening can cause channel incision that propagates upstream (headcutting) and accelerates bank erosion. Extensive and rapid bank erosion indicates a very unstable stream.

Large patches of permanent vegetation produce smaller storm flows. Channels that are lined with riparian forest are more resistant to bank erosion.

Guidelines for reducing stream bank erosion

- Bank erosion is easier to control with vegetation along smaller and relatively stable streams.
- Locate agroforestry practices on both sides of a stream. Stabilizing the bank on one side of a stream can accelerate erosion on the opposite side.
- Locate and size agroforestry practices to allow for continued bank erosion until the planting matures enough to provide stability to the bank.
- Select a mixture of fast-growing, deep-rooted shrubs and trees that will protect the bank from surface scour and strengthen it against bank sloughing.
- Select shrub and tree species that can resist toppling by flood flows, and can resprout after breakage caused by floods, ice flows, and bank sloughing.
- Locally-severe bank erosion may need to be stabilized using soil bioengineering, a specialty agroforestry practice. (See AF–Notes 23 and 24 on soil bioengineering and planning streambank protection).

Landscape aesthetics and safety

Indicators: Look at the pattern of landscape elements. Uniform land cover can be monotonous. Views of industrial or urban sites may be undesirable. Noises from roads and railways and odors from livestock and waste treatment facilities diminish enjoyment of other aspects of the landscape. Blowing dust and snow create safety and health problems along roads and in residential areas.

Forested patches and corridors create visual diversity and pleasing mosaic of land covers in cultivated landscapes. Forest strips can help to block noise and undesirable views and to reduce blowing dust and snow. However, improper placement of trees can block desirable viewpoints along roads and cause snow and dust to accumulate on roadways and in urban areas.

Guidelines for enhancing landscape aesthetics and safety

- Locate agroforestry practices where they will add visual diversity to the landscape. Design plantings to mimic lines and shapes of other elements in the landscape.
- Locate agroforestry practices as close as possible to noise, odor, or other air pollutant sources, and to screen undesirable views from roadways and urban areas.
- Locate agroforestry practices away from places where they will block desirable views from roadways and nearby urban developments. Avoid creating blind spots at road intersections.
- Locate and/or orient agroforestry plantings so that they do not cause snow accumulation or blowing dust problems on roadways and in urban areas.
- Select species that will add visual appeal, such as colorful foliage, to the surrounding landscape. Create visual diversity by adding clumps of visually interesting species at the edges of each planting.

Additional information

Related Agroforestry Notes

AF Note – 20: Planning agroforestry practices. USDA National Agroforestry Center.
AF Note – 38: Landscape planning for environmental benefits. USDA National Agroforestry Center.
AF Note – 39: Conducting landscape assessments for agroforestry. USDA National Agroforestry Center.

Planning and design guides

Landscape Ecology Principles in Landscape Architecture and Land-Use Planning by W. Dramstad, J. Olson, and R.T.T. Forman, 1997. Island Press, Washington, D.C.
Conservation Buffers: Design Guidelines for Buffers, Corridors, and Greenways by G. Bentrup. 2008. USDA Forest Service, Asheville, NC.

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The USDA National Agroforestry Center (NAC) is a partnership of the Forest Service (Research and Development and State and Private Forestry) and the Natural Resources Conservation Service. It is administered by the Forest Service, Southern Research Station; its program manager and headquarters are located in Huntsville, AL, on the campus of Alabama A&M University, while its research, clearinghouse, and technology transfer staff are concentrated in Lincoln, NE, at the University of Nebraska. NAC's purpose is to accelerate the development and application of agroforestry technologies to attain more economically, environmentally, and socially sustainable land use systems. To accomplish its mission, NAC interacts with a national network of partners and cooperators to conduct research, develop technologies and tools, establish demonstrations, and provide useful information to natural resource professionals.